

## Claims

### What is claimed is:

1. A navigation system for a vehicle comprising:  
a digital map database containing a road network map that is divided into a plurality  
5 of road segments;  
a route planning module to calculate a route to a trip destination using the road  
network map;  
a traffic event notification device operable to receive a traffic event notification  
message indicating a traffic event has occurred along a respective road segment of the route;  
10 and  
a diversion module to retrieve an alternative route that avoids the traffic event by  
locating at least one marked diversion contained in the digital map database that is  
associated with the respective road segment where the traffic event has occurred.
- 15 2. The navigation system of claim 1 where the marked diversion is calculated  
by a traffic event simulation module employed during a map conversion process that is used  
to create the digital map database.
- 20 3. The navigation system of claim 1 further comprising a route guidance  
module for guiding the vehicle along the route and the alternative route.
4. The navigation system of claim 1 where the respective road segment is  
located between at least two intersections with other road segments.
- 25 5. The navigation system of claim 1 where the at least one marked diversion is  
calculated to begin at a first predetermined distance before the traffic event and end a  
second predetermined distance after the traffic event.
6. The navigation system of claim 1 where the at least one marked diversion is  
30 calculated to use a small functional road class to avoid the traffic event.
7. The navigation system of claim 6 where the small functional road class is  
located by searching a road class attribute found in the digital map database.

8. A method of creating a digital map database for use in a navigation system comprising:

converting a road network map that includes a plurality of road segments into a digital map file;

5       simulating a traffic event along each respective road segment of the road network map;

calculating at least one marked diversion that avoids the traffic event for each road segment; and

storing the marked diversion in the digital map file.

10       9. The method of claim 8 where converting the road network map comprises identifying the road segments as between at least two intersections with other road segments.

15       10. The method of claim 8 where calculating the at least one marked diversion comprises calculating the at least one marked diversion to begin a first predetermined distance in front of the traffic event and end a second predetermined distance behind the traffic event.

20       11. The method of claim 8 where the marked diversion is calculated to use a small functional road class to avoid the traffic event.

25       12. The method of claim 11 where the small functional road class is located by searching a road class attribute associated with each of the road segments in the road network map.

13. A computer program product for creating a digital map database for use with a vehicle navigation system comprising:

30       a computer usable medium having computer readable program code embodied in said medium for avoiding traffic events, said computer program product having:

computer readable program code to generate a road network map including a plurality of road segments;

computer readable program code to simulate a traffic event in at least one of the road segments contained in the road network map;

computer readable program code to calculate at least one marked diversion that avoids the traffic event; and

computer readable program code to store the at least one marked diversion in a digital map database.

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14. The computer program product of claim 13 where each of the road segments are located between at least two intersections of the road segments.

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15. The computer program product of claim 13 where the at least one marked diversion is calculated based on a shortest travel time factor.

16. The computer program product of claim 13 where the at least one marked diversion is calculated using a small functional road class to avoid the traffic event.

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17. The computer program product of claim 13 where the at least one marked diversion is calculated to begin a first predetermined distance before the traffic event and end a second predetermined distance after the traffic event.

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18. The computer program product of claim 13 where the traffic event is simulated on consecutive road segments.

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19. A map conversion system for creating a digital map database comprising:  
means for generating a road network map including a plurality of road segments;  
means for simulating a traffic event in at least one road segment contained in the road network map;

means for calculating at least one marked diversion that avoids the traffic event; and  
means for storing the at least one marked diversion in a digital map database.

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20. The map conversion system of claim 19 where the at least one road segment is located between two intersections of other road segments.

21. The map conversion system of claim 19 where the at least one marked diversion is calculated to avoid the traffic event using a shortest distance factor.

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22. The map conversion system of claim 19 where the at least one marked diversion is calculated to begin a first predetermined distance before the traffic event and end a second predetermined distance after the traffic event.

5 23. The map conversion system of claim 19 where the at least one marked diversion is calculated to use a small functional road class to avoid the traffic event.

24. The map conversion system of claim 23 where the small functional road class is determined as a function of a road class attribute.

10 25. A navigation system comprising:  
a route planning module configured to calculate a route to a trip destination using a road network map that includes a plurality of road segments;  
a simulation module configured to simulate a traffic event in each of a plurality of  
15 road segments along the route;  
a diversion module configured to calculate at least one marked diversion that avoids the traffic event in each of the road segments; and  
a memory device to store the at least one marked diversion for use if a respective traffic event occurs along the route at one of the respective road segments.

20 26. The navigation system of claim 25 where each of the road segments are located between at least two intersections with other road segments.

25 27. The navigation system of claim 25 where the at least one marked diversion is calculated to begin a first predetermined distance before the traffic event and end a second predetermined distance after the traffic event.

28. The navigation system of claim 25 where the marked diversion is calculated to use a small functional road class to avoid the traffic event.

30 29. The navigation system of claim 28 where the small functional road class is located by searching a road class attribute found in a digital map database.

35 30. The navigation system of claim 25 where the at least one marked diversion is calculated to end a predetermined distance after the traffic event.

31. The navigation system of claim 25 where the at least one marked diversion is calculated to avoid consecutive traffic events along consecutive road segments along the route.

5 32. The navigation system of claim 25 further comprising a traffic message receiving device for receiving a notification of the traffic event.

10 33. A method of avoiding traffic events with a navigation system comprising:  
creating a route to a predetermined destination on a road network map;  
dividing the route on the road network map into a plurality of road segments;  
simulating a traffic event on each road segment along the route;  
calculating at least one marked diversion around each respective simulated traffic event;  
15 storing the at least one marked diversion in a memory location; and  
creating an alternative route with the at least one marked diversion when an actual traffic event occurs on a respective road segment.

20 34. The method of claim 33 where functional road classes are ignored when calculating the at least one marked diversion.

35 35. The method of claim 33 where dividing the route comprises locating each of the road segments between at least two road intersections in the road network map.

25 36. The method of claim 33 where the traffic events are simulated on consecutive road segments.

30 37. The method of claim 33 where the at least one marked diversion used to create the alternative route is selected based on a shortest time factor.

35 38. The method of claim 33 where the at least one marked diversion used to create the alternative route is selected based on a shortest distance factor.

39. The method of claim 33 further comprising receiving a traffic event notification from a traffic event notification device.

40. The method of claim 33 where the at least one marked diversion is calculated to begin a first predetermined distance before the traffic event and end a second predetermined distance after the traffic event.

5 41. The method of claim 33 where the at least one marked diversion is calculated to use a small functional road class to avoid the traffic event.

10 42. The method of claim 41 where the small functional road class is determined by searching a road class attribute found in a digital map database.

43. A computer program product for use with a vehicle navigation system comprising:

15 a computer usable medium having computer readable program code embodied in said medium for avoiding traffic events, said computer program product having:

computer readable program code to calculate a route to a destination using a digital road network map that includes a plurality of road segments;

computer readable program code to simulate a plurality of traffic events in the road segments along the route;

20 computer readable program code to calculate a plurality of marked diversions around the traffic events using alternative routes determined from the digital road network map; and

computer readable program code to store the marked diversions in a memory location.

25 44. The computer program product of claim 43 further comprising computer readable program code to use at least one of the marked diversions if a traffic event is experienced along a respective road segment of the route.

30 45. The computer program product of claim 44 where at least one of the marked diversions used is selected based on a shortest travel time factor.

46. The computer program product of claim 43 further comprising computer readable program code to determine a shortest marked diversion along the route, where the

shortest marked diversion is used if a traffic event is experienced in a road segment along the route.

47. The computer program product of claim 43 where at least one of the marked  
5 diversions is calculated using a small functional road class to avoid the traffic event.

48. The computer program product of claim 43 where at least one of the marked  
diversions is calculated to begin a first predetermined distance before the traffic event and  
end a second predetermined distance after the traffic event.

10 49. The computer program product of claim 43 where the traffic event is  
simulated on consecutive road segments.

50. The computer program product of claim 43 further comprising computer  
15 readable program code to receive a traffic event notification from a traffic event notification  
device that sets forth the traffic event.

51. A navigation system, comprising:  
means for determining a route to a destination using a road network map having a  
20 plurality of road segments;  
means for simulating at least one traffic event on at least one respective road  
segment along the route;  
means for calculating at least one marked diversion that avoids the at least one  
traffic event along the route; and  
25 means for storing the marked diversion in a memory location.

52. The navigation system of claim 51 further comprising means for retrieving a  
respective marked diversion if a respective traffic event is experienced along the route.

30 53. The navigation system of claim 52 further comprising means for guiding a  
user along the respective marked diversion if a respective traffic event is experienced along  
the route.

54. The navigation system of claim 51 where the at least one marked diversion is  
35 calculated to avoid the at least one traffic event using a shortest distance factor.

55. The navigation system of claim 51 where each of the road segments are located between at least two intersections of the road segments.

5 56. The navigation system of claim 51 where the at least one marked diversion is calculated to begin a first predetermined distance before the traffic event and end a second predetermined distance after the traffic event.

10 57. The navigation system of claim 51 where the at least one marked diversion is calculated to use a small functional road class to avoid the traffic event.

58. The navigation system of claim 57 where the small functional road class is determined as a function of a road class attribute found in a digital map database.

15 59. The navigation system of claim 51 where the at least one marked diversion is calculated to end at a predetermined distance beyond the traffic event along the route.

20 60. The navigation system of claim 51 where the at least one traffic event is a plurality of traffic events and the at least one marked diversion is calculated to avoid consecutive traffic events along more than one of the road segments along the route.

61. The navigation system of claim 51 further comprising a traffic event notification device for receiving a notification of the at least one traffic event.

25 62. A method of avoiding traffic events with a navigation system comprising the steps of:

creating a route to a predetermined destination on a road network map that includes a plurality of road segments;

simulating a traffic event on each road segment along the route;

30 calculating at least one marked diversion around each respective traffic event for each road segment;

storing each marked diversion in a memory location that is associated with the road segment;

35 receiving a notification of a respective traffic event in a predetermined road segment along the route from a traffic event notification device; and



retrieving a respective marked diversion from the memory location for use in avoiding the traffic event set forth in the notification.